Elimination of Illicit Connections in Coastal New Hampshire Spurs Cooperation and Controversy

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Introduction

Discharging stormwater runoff into our waterways has long been an accepted practice. In theory, storm drainage pipes should only discharge during and after storm events unless the source is groundwater or surface water piped underground. Therefore, the dry weather discharge should be relatively free of contaminants. However, many communities across the country are finding out this is not always true. Some cities and towns are discovering illegal connections of residential and commercial sewer lines to storm water collection systems. Illicit connections have been identified by the New Hampshire Department of Environmental Services (DES) as the point source of high fecal coliform levels in the New Hampshire coastal basin (Jones, 1995). These illegal connections pose a health risk to those recreating in the coastal waters and have forced the closure of shellfish growing waters to harvesting.

Goals of the Coastal Investigations Programs

Determining the extent of dry weather contamination in storm drainage systems is the first step an investigator should take when researching stormwater pollution. Dry weather flows in storm drainage systems are often the result of groundwater infiltration, but can also result from inappropriate connections from commercial, industrial, or residential buildings. In 1996, the New Hampshire DES published the Coastal Basin Nonpoint Source Pollution Assessment and Abatement Plan (NHDES, 1996) that directed coastal investigations of each community's storm drainage system during dry weather. This decision to conduct dry weather investigations in the coast was made after 300 illicit connections were identified in the northern New Hampshire city of Berlin. State environmental officials were convinced that illicit connections were always present in storm drainage systems that were once considered a pollution threat only during wet weather.

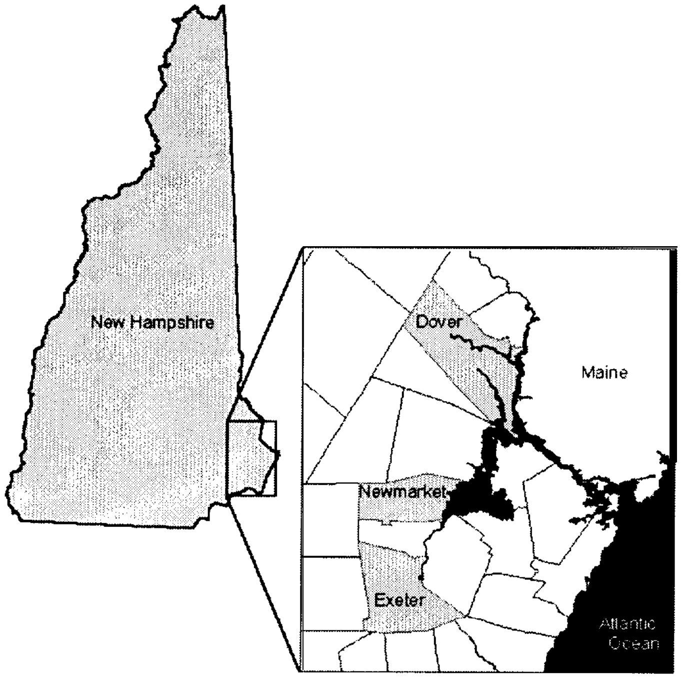
DES initiated a multi-year effort that focused on identifying and abating the sources of the bacterial violations found in the state's coastal waters with the goal of opening shellfish growing waters during dry weather (Landry, 1997). About the same time, the New Hampshire Estuaries Project (NHEP) began a three-year process of developing a comprehensive management plan aimed at restoring, protecting and enhancing the water quality and living resources of the state's estuaries. The major goal of the NHEP was to address the sources of pollution currently impacting the estuaries and prevent future problems through effective land use planning and shoreline protection of the coastal resources (NHEP, 1996). To accomplish this goal, part of the NHEP strategy was to locate and remediate the sources of the water quality violations, primarily bacterial violations, found in the estuaries and coastal waters (Landry, 1997). DES and NHEP combined resources and developed an investigation strategy with the overall goal of improving and protecting estuarine water quality.

Specific Program Objectives

The main objectives of the investigation strategy were to identify inappropriate connections in the storm drainage systems of urban, coastal communities and to eliminate the illicit connections through the available means, which include voluntary compliance and enforcement.

A Brief Look at Coastal New Hampshire

The eighteen miles of New Hampshire coastline do not begin to tell the story of the state's abundant marine resources. The relatively modest coastline is only a small part of the coastal basin. The estuarine resources include the Great Bay Estuary and seven associated tidal rivers, Hampton Harbor, and Rye Harbor. These waters are used by residents and many visitors for swimming, boat touring, shellfish harvesting, surfing, and angling. Forty-two communities



comprise the coastal basin watershed, with a population density just under 300 residents/mile^2 (Jones, In Review). The upper watershed is generally undeveloped and forested while the more urban centers are situated in the lower watershed as the rivers approach the coast.

Ten wastewater treatment facilities are situated on the tributaries of Great Bay and Hampton Harbor and two facilities discharge directly into the Atlantic Ocean. Coastal communities are working diligently to upgrade the wastewater treatment facilities and sewage collection systems. Inflow/infiltration problems and undersized pump stations plague the treatment facilities and have resulted in financial hardshipsforaffected municipalities. Shellfish growing waters have been temporarily closed after heavy rainstorms when bacteria levels rise due to sewage by-passes. Sewage is a well-recognized threat to the marine environment because it often contains harmful chemicals, disease-causing bacteria and viruses, dissolved material and solid matter. Pathogens can cause a variety of illnesses and humans are exposed to these organisms through contaminated water, shellfish, and fish (Sea Grant, 1999).

Investigating Illicit Connections

Recently, more and more watershed studies are investigating inappropriate discharges in storm drainage systems. This pollution source originates from an identifiable point and flows through the storm drainage system to the outfall pipe. For example, instead of connecting to the sewer system, a direct connection of sewer service discharges into the storm drainage system. Other inappropriate sources include floor drains and laundry pipes. These inappropriate connections are also referred to as illicit or illegal cross connections. The health threat and the potential to interfere with stormwater contamination assessments elevate illicit connections to priority status for watershed managers to investigate.

Pitt et al. (1993), in cooperation with the Center of Environmental Research Information, U.S. Environmental Protection Agency, published a user's guide for conducting investigations of illicit connections. Several of the methods suggested in this guide were implemented during the New Hampshire coastal investigations. Detailed surveys to determine the extent of contamination through specific water quality monitoring and careful observation of storm drainage outfalls are recommended for each type of land use in the watershed. Pitt recommends an initial phase of investigative protocol that includes the initial mapping and field surveys. The initial activities are followed by more detailed watershed surveys to locate and correct the sources of the contamination in the identified problem areas. After corrective action has been taken, repeated outfall field surveys are required to ensure that the outfalls remain uncontaminated.

Surveys of Storm Drainage Systems

Over the course of the investigations, several methods were used, ranging from the initial screening process of surveying storm drainage discharges to dye testing the indoor plumbing of suspected sources. Steps between the initial survey and the final determination of the source, included analyzing the discharge for water quality; visual and odor observations at outfalls, manholes, and catchbasins; smoke testing; and video inspection of the storm drainage and sewer systems.

Tidal rivers and coastal waters were divided into study sections by community. The urban, downtown centers of these communities were targeted based on the existence of the storm drainage infrastructure. The investigators compiled maps and as-built drawings of the storm drainage and sewer infrastructure. If the maps were inaccurate, insufficient, or unavailable, information on the storm drainage system was developed based on field investigations by the staff, typically with the assistance of public works employees.

Communities with maps based in a geographic information system (GIS) saved staff time and were generally more accurate than record drawings that are not updated regularly (Landry, 1997). Tuomari (1996) applied the Rouge Watershed Geographic Information System to the Wayne County Illicit Connections Detection Program and concluded that the new GIS strategy eliminated the need to use maps and graphics from disparate reports and sources, significantly reducing the time and effort once spent on research, field data acquisition, and interpretation.

Beginning in the summer of 1996, the coastal shorelines were surveyed at low tide, on foot or by canoe, depending on access, for potential pollution sources. All pipes, seeps, streams, and swales with flow were sampled for bacteria. In addition, temperature was measured and observations relating to the condition of the pipe (stained or structurally damaged), odor, evidence of untreated wastewater (toilet paper, etc.), turbidity, color, debris, estimated flow, and any other observations were noted. Dry pipes were rechecked on several occasions for intermittent flow. Evidence indicating the presence of wastewater and/or elevated bacteria levels prompted further investigation of these locations.

Upstream catchbasins and manholes associated with the outfall pipes that were identified in the screening process previously described, were surveyed for evidence of wastewater and sampled for bacteria. Smoke testing (using non-toxic smoke blown into catch basins) was then used to identify buildings connected to the storm drainage system by canvassing the neighborhood for vents emitting smoke. Final confirmation of an illicit connection from the buildings that emitted smoke was accomplished with dye testing of indoor plumbing and observing the storm drainage and sewer systems for the presence/absence of the dye.

Feeder streams were surveyed for outfall pipes with dry weather flow. Other potential bacteriological sources (e.g., pigeon roosting sites on bridges) were bracketed with water quality sampling stations. Where contaminated seeps and swales were suspected, the drainage area was surveyed for potential sources such as broken sewer mains.

Water Quality Results

Bacteria data (1997/98) from outfall pipes with confirmed cross connections ranged from 1,700 - >1,000,000 *E. coli* counts/l 00 ml during dry weather in Dover, New Hampshire. Many outfall pipes with cross connections had a gray biomat comprised of filamentous bacteria coating the inside of the pipe and, often, the rocks or sediment below. These biomats were used as a wastewater indicator based on the presence of these mats at more than 50% of the outfalls with confirmed cross connections.

Dr. Stephen Jones of the University of New Hampshire Jackson Estuarine Laboratory conducted a twelve-month study that examined the significance of all flow coming from urban storm drainage systems in the downtown Dover watershed of the Cocheco River (Jones, 1998). Jones found that storm drains were consistent sources of relatively high concentrations of bacterial indicators and pathogens at concentrations that exceeded state standards for recreational and shellfish-growing waters during both dry and wet weather.

Flow from a damaged stormwater outfall pipe was determined to have a geometric mean *E. coli* concentration of 1,047,199 cfu/100 ml and a dissolved inorganic nitrogen (DIN) concentration of 22.4 mg/l. The data were brought to the attention of DES and an investigation revealed a cross connection from a commercial building. Dr. Jones continued to monitor the quality of flow after the cross connection was eliminated and the results show a significant decline in both bacteria and DIN geometric means. The post-repair results were 93 *E. coli* cfu/100 ml and 7.2 DIN mg/l.

Although no public health problems were known to have occurred as a result of exposure to bacterial pathogens in the Cocheco River, the contamination may be a significant contribution to the fecal-borne bacteria that are presently the reason for closing the area's shellfish growing waters in New Hampshire and restricting harvests in Maine (Jones, 1998).

Remedial Actions

Once confirmed, illicit connections in coastal New Hampshire have been eliminated in different ways. The most desired course of action from the regulatory perspective is voluntary compliance and many fixes have been accomplished through this process. Economics and prioritization of the many demands on public works departments sometimes compel the state and federal environmental agencies to initiate regulatory action to eliminate raw wastewater discharges into surface waters. Lawsuits, although not common, have been filed against municipalities after cross connections were discovered.

Voluntary Compliance: Town of Exeter Case Study

In 1994, researchers at the UNH Jackson Estuarine Laboratory (Jones and Langan, 1995) reported elevated dry-weather bacterial levels collected in Norris Brook, a tributary to the Squamscott River in Exeter, New Hampshire. In 1996, DES collected bacteria samples at various locations on Norris Brook (NHDES, 1997) and found relatively low *E. coli* concentrations of <150 counts/l00 ml. In 1998, an Exeter official urged DES to investigate the watershed for contamination based on the 1994 data that showed a fecal coliform concentration of 600 counts/l 00 ml. In April of 1998, DES and a town official conducted a survey of the lower watershed and discovered a storm drainage outfall discharging a large volume of flow even though the weather had been dry. Upon closer inspection, toilet paper was observed in the outfall pipe and the immediate area.

The town public works department was notified of the survey results and, following reminders by DES, began investigations to determine the sources of untreated wastewater. Progress was slowed because several of the residences were rental properties which involved contacting the owner, who was in some cases from out-of-state, and gaining permission to access the building for dye testing. By November, the town reported that a few of the cross connections still remained. DES considered enforcement action and an administrative fine but did not take that action to maintain the spirit of cooperation. In January of 1999, the town reported that the owner of the last remaining property to be dye tested was not responding to requests for access. More prodding by DES followed and in February 1999, DES received notification that the cross connections were eliminated. A follow up inspection confirmed the absence of untreated wastewater in the storm drainage outfall.

A lesson learned from this experience is that a persistent, local advocate is often the key to maintaining attention on a local water quality problem. In addition, local advocates, whether a conservation commissioner, selectmen, or citizen, often have detailed knowledge of the complaint and the locale, which provides valuable and time-saving information to the state investigators.

Time and resource demands on local officials as well as state investigators can cause this process to be distressingly slow. Budgeting for 2-3 cross connection investigations and fixes per year is recommended at approximately $6,000 per fix, to help alleviate the unexpected financial burdens on urban communities when illicit connections are found.

Bacteria alone should not be the determining factor of the presence or absence of an illicit connection for a variety of reasons. Chlorine or other toxins in untreated wastewater may depress bacteria levels and bacteria lack conservative behavior, which deem it a poor indicator (Pitt, 1993). Investigators have found that a careful and thorough outfall survey is usually more informative than just collecting water samples.

Enforcement Action: City of Newmarket Case Study

Enforcement is another tool available to DES to achieve compliance. For example, setting timetables for compliance milestones in a legal document is a method that, while typically thought of as a burden to a community, may actually provide the impetus for action in a positive way. Public works departments of New Hampshire coastal communities are not equipped with large, discretionary budgets to address unplanned remediation of illicit connections. When faced with this dilemma, an enforcement action against the community provides public works departments with the validation to support a request for additional funding from the officials who approve the allocation of funds.

As the mill Town of Newmarket, New Hampshire, developed over the years, a small watercourse named Moonlight Brook was built over and culverted in the center of downtown. In 1996, DES investigated Moonlight Brook based on historic elevated bacteria levels. The DES investigation revealed dry weather *E. coli* concentrations as high as 41,600 counts/l 00ml in the brook. DES encouraged the town to initiate dye testing of the structures in the vicinity of Moonlight Brook but, at that time, the town was reluctant to allocate staff and funding for clean up efforts (NHDES, 1997).

An administrative order was issued by the US Environmental Protection Agency for various violations of permitted effluent limitations in October, 1997 and included a requirement that the town eliminate the raw sewage discharges from the storm sewer system (USEPA Docket No. 97-78). The order required a plan and schedule for eliminating any pollutants discharging during dry weather. The order also specified sampling of each active dry weather discharge that remained following elimination of the illicit connections to the system identified by the town's fieldwork.

In response to the order, the town hired an environmental consultant to address the problems at the wastewater treatment facility and the illicit connections. During the summer of 1997, the consultant and the town performed a dye study of the subdrainage area that the town suspected was the likely source of bacterial contamination identified at the discharge. The dye study resulted in the identification of a total of four untreated discharges to the storm drainage system from three properties. A subsequent video inspection of the sewer lines adjacent to these properties revealed that the sewer service connections from these properties might have been installed at the time the original sewer was constructed. The consultant then concluded that this would indicate the sources of sewage discharging to the storm drainage are broken sewer service connections rather than direct connections. The town stated that the remedial work would be completed by June 1998 (Plante, 1998).

Another storm discharge pipe servicing this area was separated in 1985 and 1986, at which time dye testing was performed to identify sanitary services that were connected to the sewer. The consultant determined that it would be unlikely that direct sanitary service connections to the storm drain were present in this area, however, broken service connections could result in sewage entering the storm drain culvert along Main Street. A dye study was planned for May 1998.

A total of 59 properties were included in the dye-testing program. Four of the properties were confirmed to be cross-connected to the storm drainage system. Two of the four were the result of direct connections of sewer laterals to the drainage system. The remaining two were a result of exfiltration from the sewer lateral through the ground to the drain line (Town of Newmarket, 1999). The town reports a 90% reduction in the *E. coli* counts following the elimination of the illicit discharges.

Legal Action: City of Dover Case Study

In the 1970's, the City of Dover, New Hampshire, constructed a new sewage collection system and treatment facility. In 1997, DES investigators began surveying the storm drainage outfalls for contamination. Around this same time, University of New Hampshire researcher Dr. Stephen Jones initiated a study in Dover to determine the significance of flow (both dry and wet weather) coming from urban storm drainage systems (Jones, 1998). Jones identified a source of bacterial contamination to be a cross connection later confirmed by DES and the City of Dover Public Works Department. The city fixed the illicit connection by connecting the sanitary service into the sewer main, at no charge to the building owner, while noting substantial flow from this service due to a hair salon in the building.

After learning about the existence of the cross connection, the building owners made an unsuccessful request to the city for an abatement of the sewer fees they had paid since 1981 and initiated legal proceedings. The city alleged that the case law mandated a decision in its favor and filed a motion for summary judgement (Strafford Superior Court, Order #98-C-207). In a responding order from the judge, the case law was said to illustrate that the Court had considered a variety of factors in related cases including (1) whether the new and old system were integral to one another, (2) whether the benefit provided to the plaintiff under the new and old systems was comparable, and (3) whether the property owner had access to the new system. The motion for summary judgment was denied because the Court found that these were issues for a jury and that summary judgment at that stage would be premature.

A trial date was set. One week before the trial was to occur, the two parties settled out of court. The terms of the settlement were confidential. If the property owners were successful in seeking a tax abatement and damages for unjust enrichment, implied contract, and negligent misrepresentation, as sought, the pollution investigations could have been in jeopardy of becoming ineffective. Such a precedent could have led to other similar suits and would effectively remove the incentive for municipalities to be proactive in fixing cross connections.

Conclusions

The Department of Environmental Services, in conjunction with the New Hampshire Estuaries Project, has systematically identified illicit connections in the urban communities of coastal New Hampshire. Applying both voluntary compliance and enforcement has resulted in the removal of cross connections to the storm drainage systems and a decrease in the contamination reaching the coastal surface waters. DES is currently monitoring the shellfish growing waters to determine the extent of water quality improvement resulting from the removal of illicit connections.

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